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TITLE: FLUID CONTROL SYSTEMS AND METHODS

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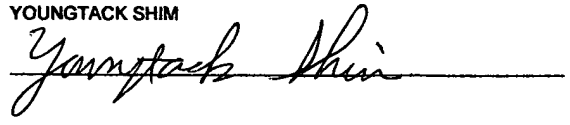

TITLE OF THE INVENTION
FLUID CONTROL SYSTEMS AND METHODS

The present application claims a benefit of an earlier filing date of a U.S. Provisional Application having a Serial Number U.S.S.N. 60/466,859, filed on May 2, 2003, and entitled "Fluid Control Systems and Methods Therefor," an entire portion of which is incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates to fluid control systems and methods therefor. More particularly, such fluid control systems and methods of this invention are designed to allow opening and closing of mixed fluid only at a downstream of a junction where at least two streams of fluids having different properties are arranged to mix together. Thus, such fluid control systems and methods of the present invention allow an user to start or stop dispensing of the mixed fluids at any time and in any number of occasions without having to require the user to readjust control valves to obtain a desired property of the mixed fluids.

BACKGROUND OF THE INVENTION

Various water control devices have been developed and in use in showers, sinks, and other industrial applications. In general, an user has to adjust one or more upstream valves for hot and cold streams of water to dispense mixed water having a right temperature. When the user does not need to dispense the water temporarily, he or she has to close the valves to stop dispensing of water, and subsequently has to readjust such valves to obtain the water having the same or similar temperature. Such an inconvenience generally leads the user to leave the water on even when he or she does not need it. During a shower, *e.g.*, the user does not need the water running while putting a soap on his or her body, putting a shampoo or rinse on his or her hair, and the like. In order to obviate the need to readjust the valves, however, the user may leave the water running, step aside from the water while putting on the soap, shampoo or rinse, and then comes back to the running water to wipe away the soap, shampoo or rinse, thereby wasting a great amount of water. The same situation may also arise in the sinks and even in industrial settings.

Accordingly, there is a need for water control systems and methods therefor to start and stop dispensing of mixed water while obviating the user from subsequently readjusting the valves to obtain the mixed fluids having the same or similar temperature.

SUMMARY OF THE INVENTION

The present invention relates to fluid control systems and methods therefor. More particularly, such fluid control systems and methods of this invention are designed to start and stop dispensing of mixed fluid only at a downstream of a junction in which at least two streams of fluids having different properties are arranged to mix together. Thus, such fluid control systems and methods of the present invention allow an user to start or stop dispensing of the mixed fluids at any time and in any number of

occasions without having to require the user to readjust control valves to obtain the mixed fluids with a desirable property.

In one of the present invention, a fluid control system is provided to control a flow of a mixed fluid through a fluid control device arranged to adjust flows of multiple raw fluids therethrough. Such a mixed fluid is generally formed by mixing the raw fluids in a junction which is generally disposed in the fluid control device and arranged to demarcate an upstream of the device through which the raw fluids flow from a downstream of the device through which the mixed fluid flows. In general, the raw fluids have at least one different property and are supplied by different fluid sources each of which is disposed in the upstream of the device. Such a fluid control device is also equipped with at least one upstream valve which is generally disposed in the upstream and arranged to adjust amounts of such raw fluids flowing therethrough in order to form the mixed fluid having at least one desirable property in the downstream of the device. In one embodiment, such a fluid control system may include at least one downstream valve which is disposed in the downstream and arranged to stop and to resume (or to regulate an amount of) the flow of the mixed fluid therethrough. In another embodiment, such a fluid control system may include at least one downstream valve which is disposed in the downstream and arranged to move substantially only between a closed position and an open position so as to stop and to resume the flow of the mixed fluid therethrough, respectively. In yet another embodiment, the fluid control system may include at least one downstream valve disposed in the downstream and having a handle arranged to rotate (to turn or to swivel) by no more than a single revolution between a closed position and an open position thereof respectively in order to stop and to resume the flow of the mixed fluid through the downstream valve. In another embodiment, the fluid control system may also include at least one downstream valve which is disposed in the downstream and includes at least one switch arranged to be pushed (pressed, pulled or translated) to move between a closed position and an open position thereof respectively to stop and resume the flow of the mixed fluid through the downstream valve. The foregoing downstream valve may also be arranged not to operatively and/or mechanically couple with the upstream valve or, in the alternative, to be operatively and/or mechanically uncoupled to the upstream valve. In an alternative embodiment, the fluid control system may include at least one downstream valve which may be disposed in the downstream, mechanically supported at least partly by at least a portion of the upstream valve, and arranged to stop and to resume the flow of the mixed fluid therethrough. In a different embodiment, the fluid control system may include a spout and at least one downstream valve. The spout is typically disposed in the downstream to dispense the mixed fluid therethrough, and the downstream valve may be similar to one of the above exemplary valves such as, *e.g.*, may be disposed in the downstream, mechanically supported at least partly by the spout, and arranged to stop and resume the flow of the mixed fluid therethrough. In another embodiment, such a fluid control system may include a shower head and at least one downstream valve. Such a shower head is disposed in the downstream to dispense the mixed fluid therethrough, while the downstream valve is disposed in the downstream, mechanically supported at least partly by the shower head, and arranged to stop and to resume the flow of the mixed fluid therethrough. In yet another embodiment, the fluid control system may include a sink faucet and at least one downstream valve. The sink faucet

is disposed in the downstream to dispense the mixed fluid therethrough, while the downstream valve is disposed in the downstream, mechanically supported at least partly by the faucet, and arranged to stop and resume the flow of the mixed fluid therethrough. The foregoing fluid control system may also include at least one rotatable handle or at least one switch which may be pushed, pressed, swiveled, pulled, rotated, and/or translated. In another embodiment, the fluid control system may include at least one downstream valve which is comprised of at least one handle (or switch), at least actuator, and at least one connector. The handle (or switch) may be generally arranged to rotate, to move or translate no more than a single revolution between a closed position and an open position at least substantially independently of the upstream valve. The actuator may be arranged to block and resume the flow of the mixed fluid therethrough, respectively, in the closed position and in the open position of the handle or switch. The connector may be arranged to operatively couple the handle or switch to the actuator which may be disposed in the downstream of the junction.

In another aspect of the present invention, a method may be provided to regulate (or to control) a flow of a mixed fluid through a conventional fluid control device arranged to adjust flows of multiple raw fluids. The mixed fluid is formed by mixing the raw fluids in a junction disposed in the device and arranged to define an upstream of the device through which the raw fluids flow and a downstream of the device through which the mixed fluid flows. The raw fluids have at least one different physical or thermal property and is supplied by different fluid sources disposed in the upstream. The fluid control device may also include at least one upstream valve which is disposed in the upstream and arranged to adjust amounts of the raw fluids flowing therethrough to provide the mixed fluid having at least one desirable property in the downstream. Such a method may include the steps of opening the upstream valve to mix a first raw fluid with a second raw fluid in the junction, dispensing the mixed fluid through the downstream of the fluid control device, manipulating the upstream valve to adjust the amounts of the first and second raw fluids so as to obtain the mixed fluid having the desirable property, disposing at least one downstream valve in the downstream of the fluid control device, closing the downstream valve to stop or to halt the flow of the mixed fluid through the downstream of the fluid control device without manipulating (or having to manipulate) the upstream valve, and opening the downstream valve thereafter to resume the flow of such a mixed fluid through the downstream of the fluid control device without manipulating (or having to manipulate) the upstream valve. In another embodiment, the method may include the steps of opening the upstream valve to mix a first raw fluid with a second raw fluid in the foregoing junction, dispensing the mixed fluid through the downstream of the fluid control device, manipulating the upstream valve to adjust the amounts of the first and second raw fluids to obtain the mixed fluid having the desirable property, incorporating in the downstream of the fluid control device at least one downstream valve arranged to move substantially only between a closed position and an open position, moving the downstream valve to the closed position thereof in order to stop the flow of the mixed fluid through the downstream without manipulating (or having to manipulate) the upstream valve, and moving the downstream valve thereafter to the open position thereof to resume the flow of the mixed fluid through the downstream without manipulating (or having to manipulate) the upstream valve. In another embodiment, the method may include the steps of opening the upstream valve to mix

a first raw fluid with a second raw fluid in the above junction, dispensing the mixed fluid through the downstream of the fluid control device, manipulating the upstream valve to adjust the amounts of the first and second raw fluids in order to obtain the mixed fluid having the desirable property, disposing in the downstream of the fluid control device at least one downstream valve with at least one handle, rotating, turning or swiveling the handle of the downstream valve to a closed position or in (along) one direction by no more than one revolution to stop the flow of the mixed fluid through the downstream without manipulating (or having to manipulate) the upstream valve, and rotating, turning or swiveling the handle of the downstream valve to its open position or in (along) an opposite direction by no more than one revolution in order to resume the flow of such a mixed fluid through the downstream without manipulating (or having to manipulate) the upstream valve. in yet another embodiment, the method may include the steps of opening the upstream valve to mix a first raw fluid with a second raw fluid in the junction, dispensing the mixed fluid through the downstream of the fluid control device, manipulating the upstream valve so as to adjust amounts of the first and second raw fluids to obtain the mixed fluid having the desirable property, disposing in the downstream of such a fluid control device at least one downstream valve with at least one switch (or multiple switches), pressing, pulling or translating the switch, a portion of the switch or one of multiple switches of such a downstream valve to its closed position or in (along) one direction by no more than one revolution so as to stop the flow of the mixed fluid through the downstream without manipulating (or having to manipulate) the upstream valve, and pulling, pressing or translating the switch, another portion of the switch or another of the switches of the downstream valve to its open position or in (along) another direction similarly by no more than one revolution in order to resume the flow of the mixed fluid through the downstream without manipulating (or having to manipulate) the upstream valve. In yet another embodiment, the method may also include the steps of opening the upstream valve to mix a first raw fluid with a second raw fluid at the junction, dispensing the mixed fluid through the downstream of the device, manipulating the upstream valve to adjust amounts of the first and second raw fluids to obtain the mixed fluid with the desirable property, disposing at least one downstream valve in the downstream of the device, closing the downstream valve by at least one of rotating, turning or swiveling at least a first portion of the downstream valve to its closed position or in (along) one direction by no more than a single revolution and then pressing, pulling or translating at least a second portion of the downstream valve to the closed position to stop the flow of the mixed fluid through the downstream without having to manipulate the upstream valve, and then opening the downstream valve by rotating, turning or swiveling at least a third portion of the downstream valve to its open position or in another direction by no more than a single revolution or pulling, pressing or translating at least a fourth portion of the downstream valve to the open position to resume the flow of the mixed fluid through the downstream without having to manipulate the upstream valve. The above methods may also include one or more of the following steps of connecting a fixed shower head to an end of the downstream spout, connecting a hand-held shower head to an end of the downstream spout, connecting a sink faucet to an end of the downstream spout, connecting a tub spout to an end of the downstream spout, disposing at least a portion of the downstream valve in the upstream, operatively or mechanically uncoupling the downstream valve from the upstream valve, and

the like. In another aspect of this invention, the method may include the steps of opening the upstream valve to mix a first raw fluid and a second raw fluid at the above junction, dispensing the mixed fluid out of the fluid control device through the downstream, manipulating the upstream valve to adjust or to control amounts of the first and second raw fluids in order to obtain the mixed fluid with the desirable property, disposing at least one downstream valve in the downstream of such a device, mechanically coupling at least a portion of the downstream valve to the upstream, closing the downstream valve to stop the flow of the mixed fluid through the downstream of the device without manipulating or having to manipulate the upstream valve, and opening the downstream valve thereafter to resume the flow of the mixed fluid through the downstream of the device without manipulating or having to manipulate the upstream valve.

In another aspect of the present invention, another method is provided to regulate a flow of a mixed fluid through a conventional fluid control device arranged to adjust flows of multiple raw fluids. The mixed fluid is formed by mixing the raw fluids in a junction disposed in the device and arranged to define an upstream of the device through which the raw fluids flow and a downstream of the device through which the mixed fluid flows. The raw fluids generally have at least one different physical or thermal property and are supplied by different fluid sources which are disposed in the upstream. The fluid control device also includes at least one upstream valve disposed in the upstream and arranged to adjust amounts of the raw fluids flowing therethrough to provide the mixed fluid having at least one desirable property in the downstream. Such a method may include the steps of opening the upstream valve to mix a first raw fluid with a second raw fluid at the junction, dispensing the mixed fluid through one of a fixed shower head, a hand-held shower head, a tub spout, and a sink faucet disposed in the downstream of the fluid control device, manipulating the upstream valve to adjust amounts of the first and second raw fluids to obtain the mixed fluid having the desirable property, disposing at least one downstream valve in the downstream of the device, closing the downstream valve by rotating, turning or swiveling at least a first portion of the downstream valve to its closed position or in (or along) one direction by no more than a single revolution or pressing, pulling, tilting or translating at least a second portion of the downstream valve to the closed position to stop the flow of the mixed fluid through the downstream without having to manipulate the upstream valve, and opening the downstream valve by rotating, turning or swiveling at least a third portion of the downstream valve to its open position or in (along) another direction by no more than a single revolution or pulling, pressing, tilting or translating at least a fourth portion of the downstream valve to the open position in order to resume the flow of the mixed fluid through the downstream without having to manipulate the upstream valve. Such a method may further include one or more of the steps of coupling at least a portion of the downstream valve in the fixed shower head, coupling at least a portion of the downstream valve in the hand-held shower head, coupling at least a portion of the downstream valve in the sink faucet, coupling at least a portion of the downstream valve in the tub spout, and operatively uncoupling the downstream valve from the upstream valve.

In yet another aspect of the present invention, a fluid control system may further be provided to control a flow of a mixed fluid through a conventional fluid control device arranged to adjust flows

of multiple raw fluids. Such a mixed fluid is formed by mixing the raw fluids in a junction disposed in the device and arranged to demarcate an upstream of the device in which the raw fluids flow from a downstream of the device in which the mixed fluid flows. The raw fluids have at least one different physical or thermal property and are supplied by different fluid sources each of which is disposed in the upstream. The device is equipped with at least one upstream valve disposed in the upstream and arranged to adjust amounts of the raw fluids flowing therethrough to form the mixed fluid with at least one desirable property in the downstream. The fluid control system may be made by a process which includes the steps of providing the upstream valve in the upstream of the junction, connecting such an upstream valve to the fluid sources so that the raw fluids from the sources may be mixed to form the mixed fluid at the junction, providing at least one downstream valve in the downstream of the junction, and operatively disposing the downstream valve such that manipulating the downstream valve but not the upstream valve may stop and resume the flow of the mixed fluid through the downstream of such a conventional device. In another embodiment, such a process may include the steps of providing the upstream valve in the upstream of the junction, providing at least one of a downstream fixed shower head, hand-held shower head, a tub spout, and a sink faucet, connecting the upstream valve to the fluid sources so that the raw fluids from the sources are mixed to form the mixed fluid in the junction, providing a downstream valve in the downstream between the junction and one of the fixed shower head, hand-held shower head, tub spout, and sink faucet, and operatively disposing the downstream valve so that manipulating the downstream valve but not the upstream valve may stop and resume the flow of the mixed fluid.

As used herein, an "upstream" generally refers to a region from multiple fluid sources down to a junction in which multiple streams of fluids each of which is supplied by each of such fluid sources and has different properties are mixed together. Based on this definition, an upstream valve as used herein represents a valve which is disposed in such an upstream, arranged to regulate a flow rate of at least one of such streams of fluids, and arranged to dispense such fluids therethrough. Therefore, such an upstream valve is always in contact with at least one of such streams of fluids and may be in contact with a mixed fluid.

In contrary, a "downstream" as used herein refers to a region ranging from a junction down to an end of a conventional fluid control device such as a shower head of a shower assembly, a faucet of a conventional kitchen assembly, and the like. Based upon this definition, a downstream valve as used herein refers to a valve which is disposed in such a downstream and arranged to control a flow of the mixed fluid therethrough. Accordingly, such a downstream valve is always in contact with the mixed fluid and does not contact any fluid stream directly supplied by one of multiple fluid sources.

A "raw fluid" refers to any fluid supplied to any conventional fluid control device by an external source of fluids, whereas a "mixed fluid" refers to a mixture of multiple raw fluids supplied by multiple external sources of fluids and mixed inside such conventional fluid control devices. The "raw fluids" generally have different properties such as, *e.g.*, different temperatures and/or flow rates, whereas the "mixed fluid" within the scope of the present invention preferably has the properties different from such properties of each of such raw fluids. As used herein, the "raw fluid" and simply "fluid" may be

interchangeably used throughout this description.

Unless otherwise defined in the following specification, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which the present invention belongs. Although the methods or materials equivalent or similar to those described herein can be used in the practice or in the testing of the present invention, the suitable methods and materials are described below. All publications, patent applications, patents, and/or other references mentioned herein are incorporated by reference in their entirety. In case of any conflict, the present specification, including definitions, will control. In addition, the materials, methods, and examples are illustrative only and not intended to be limiting.

Other features and advantages of the present invention will be apparent from the following detailed description, and from the claims.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic diagram of an exemplary prior art water control device including a pair of valves to obtain mixed water having desirable temperature;

FIG. 2A is a schematic diagram of an exemplary fluid control system for a water control device with a pair of upstream valves according to of the present invention;

FIG. 2B is a schematic diagram of an exemplary fluid control system for another water control device with a single upstream valve according to of the present invention;

FIG. 3A is a schematic diagram of an exemplary fluid control system for a fixed-head shower assembly including a pair of downstream valves according to of the present invention;

FIG. 3B is a schematic diagram of an exemplary fluid control system for a fixed-head shower assembly including a single downstream valve according to of the present invention;

FIG. 3C is a schematic diagram of an exemplary fluid control system for a fixed-head shower assembly having a pair of downstream valves and a tub spout according to of the present invention;

FIG. 3D is a schematic diagram of an exemplary fluid control system for a fixed-head shower assembly having a single downstream valve and a tub spout according to of the present invention;

FIG. 3E is a schematic diagram of an exemplary fluid control system for a fixed-head shower assembly including three downstream valves according to the present invention;

FIG. 3F is a schematic diagram of an exemplary fluid control system for a fixed-head shower assembly including three downstream valves and a tub spout according to the present invention;

FIG. 3G is a schematic diagram of an exemplary fluid control system for a hand-held shower unit according to the present invention;

FIG. 3H is a schematic diagram of a circular knob-shaped fluid control system according to the present invention;

FIG. 3I is a schematic diagram of a fluid control system concentrically implemented to a valve of a shower assembly according to the present invention;

FIG. 3J is a schematic diagram of a fluid control system implemented onto a valve of a shower assembly according to the present invention;

FIG. 4A is a schematic diagram of a fluid control system disposed at an upstream of a junction and operatively coupled to a downstream thereof according to the present invention;

FIG. 4B is a schematic diagram of a fluid control system to control a flow of a mixed fluid into a bathtub as well as into a shower head according to the present invention;

FIG. 4C is a schematic diagram of an exemplary fluid control system for a single-handle kitchen assembly including a single downstream valve according to the present invention; and

FIG. 4D is a schematic diagram of another exemplary fluid control system for a double-handle kitchen assembly including a pair of downstream valves according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention relates to fluid control systems and methods therefor. More particularly, such fluid control systems and methods of this invention are designed to start and stop dispensing of mixed fluid only at a downstream of a junction in which at least two streams of fluids having different properties are arranged to mix together. Thus, such fluid control systems and methods of the present invention allow an user to start or stop dispensing of the mixed fluids at any time and in any number of occasions without having to require the user to readjust control valves to obtain the mixed fluids with a desirable property.

FIG. 1 is a schematic diagram of an exemplary prior art water control device including a pair of valves to obtain mixed water with a desirable temperature. Such a device 10 is generally hooked up to multiple sources such as a hot water source and a cold water source. A first fluid stream such as hot water is supplied by the hot water source and delivered through a first (or hot) conduit 11 into the control device 10, and a second fluid stream such as cold water is supplied by the cold water source and delivered through a second (or cold) conduit 12 into the device 10. The first and second conduits 11, 12 extend toward each other to define a junction 13 where the streams of hot and cold water are mixed together. The device 10 also includes a first (or hot) valve 21 disposed between the hot water source and junction 13 and a second (or cold) valve 22 disposed between the cold water source and junction 13. By adjusting the first and second valves 21, 22, a user may dispense a mixed stream of water having desirable temperature through a spout 14. As illustrated in the figure, the hot, cold, and mixed water streams flow from an upstream to a downstream, where the "upstream" as used herein covers a region ranging from the hot and cold water sources down to the junction 13 and where the "downstream" as used herein covers a region ranging from the junction 13 up to an end of the spout 14. According to these definitions, the first and second valves 21, 22 are disposed in the upstream of the junction 13, while the spout 14 is disposed in the downstream of the junction 13. In addition, each fluid stream retains its physical property such as temperature in the upstream, whereas such streams come to have a mixed physical property in the downstream.

Various fluid control systems of the present invention may be implemented to the conventional fluid control devices. It is appreciated that various fluid control systems and their methods described heretofore and hereinafter are only illustrative and do not intend to limit the scope of this invention. It is also appreciated that such fluid control systems and their methods may be constructed as separate

fluid control systems including various conduits, valves, and/or spouts of the conventional fluid control devices or, alternatively, may be constructed to be retrofit into various existing conventional devices.

FIG. 2A is a schematic diagram of an exemplary fluid control system for a water control device with a pair of upstream valves according to of the present invention. Similar to the one shown in FIG. 1, the water control device may include the hot and cold water source, the first and second upstream conduits 11, 12, the junction 13, the downstream spout 14, and the first and second upstream valves 21, 22. An exemplary fluid mixing system 30 may preferably be disposed in the downstream of such a junction 13 and basically consists of a valve which may be arranged to open, close, and/or partially open or close an inner fluid conduit of the spout 14. Therefore, regardless of operational settings of the first and second upstream valves 21, 22 and mixing modes of the hot and cold water, such a fluid control system 30 of this invention may allow the user to stop dispensing the mixed water at any time and in any number of occasions. Because such a downstream fluid mixing system 30 is not coupled to the first and second upstream valves 21, 22 and does not change settings of the upstream valves 21, 22, the user can subsequently start dispensing the mixed water which has the same property as the perviously dispensed water simply by opening the fluid control system 30 of this invention.

In operation, the user opens the first and/or second upstream valves 21, 22 and dispenses the mixed water through the spout 14 while keeping the downstream fluid control system 30 or its valve in its open position. The user checks properties of the mixed water such as, *e.g.*, its temperature and/or flow rate, and turns the upstream valves 21, 22 clockwise or counterclockwise to adjust the amounts of the hot and cold water flowing therethrough until he or she is satisfied with the above properties of the mixed water. While dispensing the mixed water, when the user does not need the water running for a period, he or she simply has to close the downstream fluid control system 30, without having to regulate or even touch any of the upstream valves 21, 22 at all. When the user later needs the water back running, he or she simply has to open the downstream fluid control system 30, without having to regulate or touch any of the upstream valves 21, 22 at all.

FIG. 2B is a schematic diagram of an exemplary fluid control system for another water control device including a single valve according to of the present invention. Similar to the one shown in FIG. 1, the water control device may include the hot and cold water source, the first and second conduits 11, 12, and the spout 14. Instead of the first and second upstream valves 21, 22 of FIG. 1, however, the water control device includes a single upstream control valve 23 which is disposed approximately at an intersection of the conduits 11, 12 and/or the spout 14 and arranged to control amounts of both the hot and cold water flowing therethrough. Therefore, a junction 13 may be defined inside or at an immediate downstream of the control valve 23. An exemplary fluid control system 30 may preferably be disposed in the downstream of such a junction 13 and basically consists of a valve which may be arranged to open, close, and/or partially open or lose an inner fluid conduit of the spout 14. Similar to that of FIG. 2A, such a fluid control system 30 may also allow the user to stop dispensing the mixed water at any time and in any number of occasions without changing settings of the upstream valve 23 and to subsequently start dispensing the mixed water which has the same property as the perviously dispensed water simply by opening the downstream fluid control system 30.

In operation, the user opens the single upstream control valves 23 by turning, tilting or pulling it and dispenses the mixed water through the spout 14, with the downstream fluid control system 30 or its valve in its open position. The user checks the temperature and flow rate of the mixed water, and turns, tilts, pulls or pushes the upstream control valve 23 in order to adjust each amount of the hot and cold water flowing therethrough until the user is satisfied with the temperature and/or flow rate of the mixed water. When the user does not need the water running for some periods, he or she simply has to close the downstream fluid control system or its valve 30, without having to regulate or even touch the upstream control valve 23. When the user needs the mixed water back on running subsequently, he or she simply has to open the downstream fluid control system 30, without having to regulate or to even touch the upstream control valve 23 at all.

As described above, the simplest embodiment of the fluid control systems of this invention may be comprised of a single valve arranged to open and close an inner fluid conduit, thereby starting and stopping the dispense of the mixed fluid. The valve of such fluid control systems of this invention may optionally be arranged to regulate the flow rate of the mixed fluid as well. In general, any conventional fluid valves operating on a various fluid control mechanisms may be used in the fluid control systems. Examples of such conventional fluid valves may include, but not limited to, gate valves such as jacket gate valves and knife gate valves, glove valves including jacket globe valves, disk valves, ball valves including jacket ball valves, plug valves, butterfly valves, check valves including swing check valves, tank valves including jacket tank valves and tank bottom valves, strainers such as Y-strainers, bucket strainers, and T-strainers, back water valves, Jandy-type valves, stop valves, needle valves, rotary valves, offset valves, twin seal valves, y-pattern valves including globe stop valves, lift check valves, and lift stop check valves, and the like. Although such downstream valves of the fluid control system of the present invention may typically be two-way valves, three-way and/or four-way valves may be employed as well. In such an embodiment, a first outlet of the valve may be connected to the junction 13, a second outlet thereof may be connected to the downstream spout 14, and the rest of its outlets may be coupled to a diverter to deliver the mixed water to other parts of the device such as, *e.g.*, the shower, the bath tub, a faucet of the sink, and the like. Alternatively, one end of such a valve may be shut closed and used to stop the dispense of the mixed water when such a valve is turned to direct the mixed water to such a closed end. Instead of the valves, conventional rotary feeder may also be used as the fluid control system.

As discussed above, the fluid control systems of this invention may be applied to various fluid control and/or delivery devices. Following figures and accompanying text illustrate several exemplary embodiments of such fluid control systems applied to showers, tubs, and sinks.

First, FIGs. 3A through 3G show exemplary fluid control systems incorporated into fixed-head shower assemblies and/or held-held shower assemblies with or without tub spouts. It is appreciated that such exemplary embodiments of the fluid control systems of this invention are only illustrative and do not intend to limit the scope of this invention.

FIG. 3A is a schematic diagram of an exemplary fluid control system for a fixed-head shower assembly including a pair of downstream valves according to of the present invention, where such an

assembly includes the first and second conduits 11, 12 and the first and second valves 21, 22 which are similar to those of FIGs. 1, 2A, and 2B. Such a shower assembly further includes a shower head 15H and a shower arm 15A connecting the shower head 15H to an upper spout 14U of the shower assembly. A fluid control system 30 such as a simple gate valve or a stop valve may be disposed at any position between the junction 13 and the shower head 15H so as to allow the user to start and/or to stop dispensing the mixed fluid through the shower head 15H. FIG. 3B shows a schematic diagram of another exemplary fluid control system for another fixed-head shower assembly including a single downstream valve according to of the present invention, where another fluid control system 30 similar to that of FIG. 3A may be disposed at any location between the junction 13 and the shower head 15H.

FIG. 3C is a schematic diagram of an exemplary fluid control system for a fixed-head shower assembly having a pair of downstream valves and a tub spout according to of the present invention. Such a shower assembly is typically similar to that of FIG. 3A, except that the assembly includes a tub spout 16 and a diverter 17 which may be operatively arranged to supply the mixed water either to the shower head 15H through an upper spout 14U and shower arm 15A or to a bathtub (not shown in the figure) through the tub spout 16. FIG. 3D is a schematic diagram of an exemplary fluid control system for another fixed-head shower having a single downstream valve and a tub spout according to of the present invention, where a fluid control system 30 similar to that of FIG. 3C is disposed at any location between the junction 13 and the shower head 15H.

FIG. 3E is a schematic diagram of an exemplary fluid control system for a fixed-head shower assembly having three downstream valves according to the present invention. Contrary to the single-handle (or valve) assemblies of FIGs. 3B and 3D and the double-handle (or valve) assemblies of FIGs. 3A and 3C, that of FIG. 3E is a three-handle (or valve) assembly, in which the first one is the hot valve 21, the second one is the cold valve 22, and the third one is the diverter 24 similar to those 17 of FIGs. 3C and 3D and operatively arranged to supply the mixed water either to the shower head 15H through the upper spout 14U and shower arm 15A or to another part of the assembly such as, *e.g.*, a bathtub or a hand-held shower head unit (both not shown in the figure). A fluid control system 30 is disposed at any location between the shower head 15H and the junction 13 formed at and/or immediately distal to the diverter. FIG. 3F is a schematic diagram of an exemplary fluid control system for another fixed-head shower assembly including three downstream valves and a tub spout according to the present invention. The assembly of FIG. 3F is generally similar to that of FIG. 3E, except that the lower spout 24 is connected to the diverter 24 through which the mixed water is delivered to a tub (not shown in the figure) through the tub spout 16. Another fluid control system 30 is also disposed at any location between the shower head 15H and the junction 13 formed at and/or immediately distal to the diverter. It is appreciated that the assembly of FIG. 3F is identical to that of FIG. 3C, except that the diverter 24 of the former assembly is disposed between the first and second conduits 11, 12, while the diverter 17 of the latter assembly is incorporated into the tub spout 16.

The fluid control systems of this invention may also be implemented to conventional hand-held shower assemblies. FIG. 3G is a schematic diagram of an exemplary fluid control system for a hand-held shower unit according to the present invention. The exemplary unit 18 includes a shower head

15H and a shower arm 15A connected to the shower head 15H and bent at about 90 degrees to form a handle. A fluid control system 30 consists of a pair of toggle-type switches such as an on-switch 31N and an off-switch 31F both of which may be disposed in any location on the hand-hand unit 18, *e.g.*, along the handle.

In operation, the hand-held shower unit 18 is hooked up to the upper spout 14U of any of the foregoing water control devices after removing the fixed shower head 15H thereof. The user opens the single or double upstream valves 21-23 by turning, tilting or pulling then and dispenses the mixed water through the shower head 15H of the hand-held unit 18, with the downstream on-switch 31N of the fluid control system 30 pushed down and off-switch 31F thereof pulled up. The user checks the temperature and/or flow rate of the mixed water, and turns, tilts, pulls or pushes the upstream valves 21-23 to adjust the amounts of the hot and cold water flowing therethrough until he or she is satisfied with the temperature and/or flow rate of such mixed water. When the user does not need the water running for a period, he or she simply has to push the downstream off-switch 31F of the fluid control system without having to regulate or even touch the upstream valves 21-23. A toggling mechanism of the fluid control system 30 then automatically pulls the on-switch 31N upward. Subsequently, when the user needs the mixed water, he or she simply has to push the downstream on-switch 31N of the fluid control system 30 without having to regulate or to even touch the upstream control valve 23 at all. The toggling mechanism of the fluid control system 30 then pulls the off-switch 31F upward for a next operation.

The foregoing valves of the fluid control systems of this invention may be shaped and sized so that the user may be able to turn such valves in a clockwise and/or counterclockwise direction within preset rotation angles, as exemplified in FIGs. 2A, 2B, and 3A to 3F. In the alternative, the valves may be actuated by the toggle switches of FIG. 3G. Such valves may also be arranged to open and close by other mechanisms. For example, the fluid control systems of the present invention may be shaped as conventional control knobs. FIG. 3H is a schematic diagram of another fluid control system to have a shape of a circular knob according to the present invention. Such a knob 30 may be arranged to be rotated clockwise or counterclockwise, pulled out or pushed back, tilted upward and downward, tilted sideways, and the like. The fluid control systems of this invention may also be incorporated into other valves of the water control devices such as, *e.g.*, the hot valves, cold valves, control valves, and the like. FIG. 3I is a schematic diagram of a fluid control system concentrically implemented to a valve of a shower assembly according to the present invention, in which the fluid control system 30 includes a rotatable handle concentrically disposed behind a rotatable or tiltable control valve 23. FIG. 3J shows a schematic diagram of another fluid control system implemented onto a valve of a shower assembly according to the present invention, in which the fluid control system 30 includes a pullable knob which is implemented on top of a control valve 23.

Such fluid control systems of this invention exemplified in the foregoing figures are disposed in the downstream of the junction to control the flow of the mixed water but not to hinder or to affect the flows of the hot and cold water in any way. As long as these criteria are met, physical disposition of the fluid control systems, their valves, and/or their switches are generally not material to the scope of

this invention. For example, such flow control systems may be physically disposed in the upstream of the junction as long as such systems are operatively coupled to the downstream of the junction so as to control the flow of the mixed water through the downstream spout 14. One exemplary embodiment is shown in FIG. 4A which is a schematic diagram of an exemplary fluid control system disposed at an upstream of a junction and operatively coupled to its downstream according to the present invention, where the exemplary fluid control system 30 includes a handle 32H, a connector 32C, and an actuator 32A. As shown in the figure, the handle 32H may be disposed in the upstream of the junction 13 and arranged to receive an input from the user. The connector 32C is mechanically or electrically coupled to both of the handle 32H and actuator 32A and arranged to deliver the mechanical or electrical input from the handle 32H to the actuator 32A. The actuator 32A of the fluid control system 30 is disposed in the downstream of the junction 13. The actuator 32A preferably includes at least one control valve (not shown) disposed inside the upper spout 14U and arranged to open and close an inner conduit of the upper spout 14U, thereby controlling the flow of the mixed water through the shower head 15H without changing and/or affecting the settings of the upstream valves 21,22. It is appreciated that the above embodiment requires more mechanical and/oe electrical parts than others of FIGs. 2A, 2B, and 3A to 3F. However, this embodiment allows disposition of all control valves adjacent to each other so that the user does not need to raise his or her hand to maneuver the fluid control system 30.

The fluid control systems of this invention disclosed heretofore and hereinafter may be applied to temporarily stop dispensing the mixed water into bathtubs through the tub spouts. In one exemplary embodiment, a second fluid control system may be disposed between the junction and tub spout such that manipulation of the additional fluid control system allows the user to start and stop dispensing the mixed water into the bathtubs. The first fluid control system as exemplified in the above figures may be disposed apart from the second fluid control system and used to stop or to resume dispensing the mixed water through the shower head and so on. Any combination of the above fluid control systems of this invention may be used as the second fluid control system and disposed in almost any locations between the junction and the tub spout. Such an additional second fluid control system may also be incorporated into other parts of the water control devices. In another exemplary embodiment, a single fluid control system may be arranged to control the flow of the mixed water to the bathtub as well as to the shower head. FIG. 4B is a schematic diagram of a fluid control system for controlling a flow of a mixed fluid into a bathtub as well as into a shower head according to the present invention. Such a flow control system 30 may be disposed at or immediately distal to the junction 13 and generally be a conventional three-way and/or four-way valve which may be arranged to stop dispensing the mixed water when it may be disposed horizontally or sideways, to deliver the mixed water to the tub spout 16 when disposed downward, to deliver the mixed water to the shower head 15H through the upper spout 14U and shower arm 15A when disposed upward, and the like.

The foregoing fluid control systems and methods therefor may also be applied to control flows of mixed water in other household and/or industrial conventional water control devices such as, *e.g.*, kitchen, bathroom, and/or other sanitary faucets. For example, FIG. 4C shows a schematic diagram of an exemplary fluid control system for a single-handle kitchen assembly including a single downstream

valve according to the present invention. Similar to the above shower assemblies, a kitchen assembly includes the hot water source, the cold water source, the first and second upstream conduits 11, 12, the junction 13. The kitchen assembly also includes a single upstream valve (not shown) disposed on or over an escutcheon 19E and arranged to be connected to both of the first and second conduits 11, 12 to control both the temperature and flow rate of the mixed water through the downstream. Such a kitchen assembly also includes a faucet 19F, a faucet arm 19A, and a handle 19H which is operatively coupled to the valve and serves as an actuator thereof in response to the user control. An exemplary fluid mixing system 30 is preferably disposed at any location in the downstream of the junction 13 and basically consists of a valve which may be arranged to open, close, and/or partially open or close an inner fluid conduit of an upstream spout (not shown) disposed between the upstream valve and arm 19A. Accordingly, regardless of operational settings of the first and second upstream valves 21, 22, mixing modes of the hot and cold water, and/or an operational setting of the handle 19H, such a fluid control system 30 of this invention may allow the user to stop dispensing the mixed water at any time and in any number of occasions.

Variations and modifications of the exemplary embodiment of FIG. 4C also fall within the scope of this invention. FIG. 4D shows a schematic diagram of another exemplary fluid control system for a double-handle kitchen assembly which includes a pair of downstream valves according to the present invention. Similar to the one of FIG. 4C, a kitchen assembly shown in FIG. 4D also includes the hot and cold water source, the cold water source, and the first and second upstream conduits 11, 12. Such an assembly, however, includes a pair of exposed upstream valves 21, 22 connected to the hot and cold source, respectively, and also connected to each other through an inverter T-shaped connector 19C in which the junction 13 is formed. A distal end of such a connector 19C is connected to a faucet 19F through a faucet arm 19A. Thus, the user may control the temperature and flow rate of the mixed water by manipulating the upstream switches 21, 22, without having to adjust the handle 19H of FIG. 4C. An exemplary fluid mixing system 30 is preferably disposed at any location in the downstream of the junction 13 and basically consists of a valve which may be arranged to open, to close, and/or to partially open or close an inner fluid conduit of an upper spout 19U which is disposed between the connector 19C and the arm 19A. Therefore, regardless of operational settings of the first and second upstream valves 21, 22 and/or mixing modes of the hot and cold water, such a fluid control system 30 of this invention may allow the user to stop dispensing the mixed water at any time and in any number of occasions.

Configurational and/or operational variations and/or modifications of the foregoing fluid control systems and methods also fall within the scope of the present invention. First of all and as discussed above, such fluid control systems may include any conventional valves as long as they may open and close streams of the mixed water flowing therethrough. Such valves may include any kind of and any number of handles as long as they provide the user with good grips and easy manipulation thereof. In addition, such valves may have any shapes and/or sizes as well. Secondly, any combination of such fluid control systems may be utilized in conjunction with any combination of conventional water control devices. Accordingly, any fluid control systems of the present invention which have been described

heretofore as well as which will be described hereinafter may readily be applied to any conventional fixed-head or hand-held shower assemblies with or without tubs connected therewith, single-handle kitchen assemblies, double-handle kitchen assemblies, and other household or industrial water control devices, regardless of the number of handles or valves thereof. In addition, any fluid control systems of the present invention described heretofore and hereinafter may also be applied to any conventional shower assemblies, kitchen assemblies, and/or other household and industrial water control devices, regardless of whether such assemblies and/or devices incorporate tubs and tub spouts thereto and regardless of the presence or absence of diverters and/or spray hose units.

In addition, various fluid control systems described heretofore and hereinafter in this invention may be applied to control flows of gases and vapors as long as various valves incorporated in such fluid control systems may be capable of sealing such gases and vapors through gating mechanisms thereof. Moreover, such fluid control systems described heretofore and hereinafter in this invention may further be incorporated to various conventional fluid control devices operating electrically and/or pneumatically as long as the fluid control systems are disposed in the downstream of the junction or as long as at least a portion of such fluid control systems are operatively coupled to the downstream of the junction regardless of physical disposition of other portions of such fluid control systems. Such fluid control systems of this invention may also be operatively coupled to various sensors of electrical fluid control devices so that the user can stop and/or resume to dispense the mixed fluid by touching, tapping or disposing his or her hands or fingers.

Various exemplary fluid control systems and methods of this invention have been described. It is appreciated, however, that details of plumbing may not be material to the scope of this invention as long as such fluid control systems and methods may stop and resume dispensing of the mixed fluid in the downstream. Accordingly, various conventional fluid control devices may be mounted on walls of bathrooms or kitchens through various tubes, pipes, and fittings as well known in the art.

It is to be understood that, while various aspects and embodiments of the present invention have been described in conjunction with the detailed description thereof, the foregoing description is intended to illustrate and not to limit the scope of the invention, which is defined by the scope of the appended claims. Other embodiments, aspects, advantages, and modifications are within the scope of the following claims.

What is claimed is: